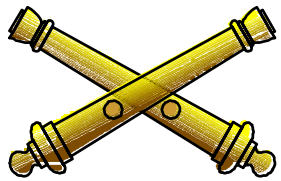
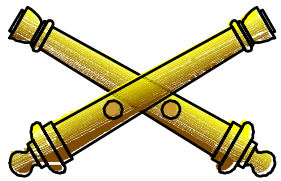
GUNNERY DEPARTMENT



THE KING OF BATTLE

USAFAS



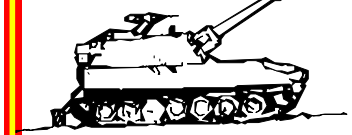
BCS TROUBLE SHOOTING

GUNNERY DEPARTMENT

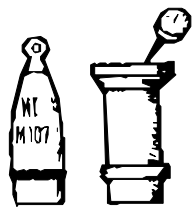
FIVE REQUIREMENTS FOR ACCURATE PREDICTED FIRE

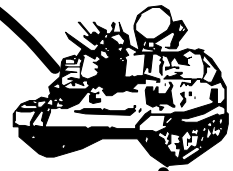
4
ACCURATE MET INFO

2
ACCURATE BATTERY LOCATION



3
ACCURATE WPN & AMMO INFO

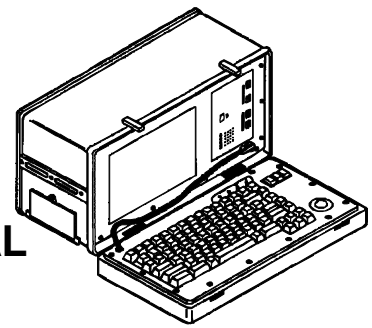




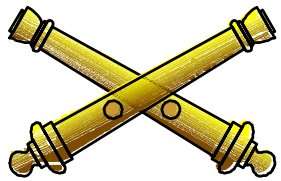
ACCURATE TARGET LOCATION AND SIZE

1

5
ACCURATE COMPUTATIONAL PROCEDURES



USAFAS

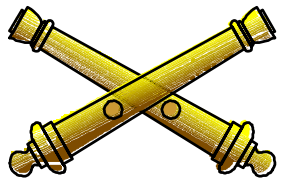


TROUBLE SHOOTING

- ISOLATE PROBLEMS
- USE A SYSTEMATIC APPROACH TO CORRECT THE FAULT

GUNNERY DEPARTMENT

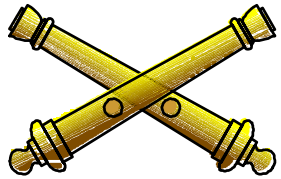
TROUBLE SHOOTING TECHNIQUES



1. IS THE ERROR GUN SPECIFIC OR ENTIRE BATTERY?
2. IS THE ERROR IN DEFLECTION, RANGE, OR HEIGHT OF BURST?
3. ONCE THE ERROR IS ISOLATED, WAS THE ERROR OF THE CORRECT MAGNITUDE AND IN THE CORRECT DIRECTION?
4. ARE THERE ANY OTHER ERRORS?
5. HAS THE DATABASE BEEN VERIFIED?
6. HAS THE GUNLINE BEEN VERIFIED?

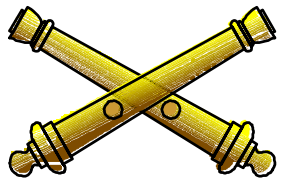
USAFAS

CORRECTING THE FAULT



ASK THE FOLLOWING QUESTIONS:

- IS IT AFFECTING MY ENTIRE BATTERY?
- IS IT AFFECTING JUST ONE GUN?
- IS IT A RANGE ERROR?
- IS IT A LATERAL ERROR?
- IS IT A RANGE AND LATERAL ERROR?
- DID THE SOLUTION SOLVE THE ENTIRE PROBLEM?

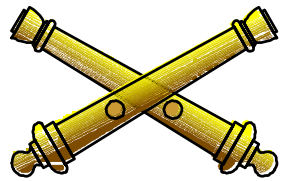


ERRORS

Range Errors	Lateral Errors	Range & Lateral
	Survey direction	Observer Location
		OT Direction
		Target Location
		ORSTA Location
		Howitzer Location
		MAPMOD

GUNNERY DEPARTMENT

SITE ERROR



BCS (CHG 4 GB RG 5000)	ACTUAL
TGT 400	TGT 350
- PLT 368	- PLT 368
VI = +32	VI = - 18
SITE = +7	SITE = - 4

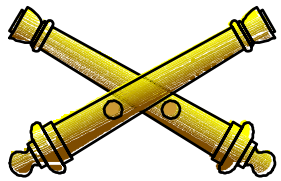
GO TO COL 5 TBL F TFT FOR RANGE CORR FOR +/-1 MIL CHANGE IN ELEVATION

(TBL F TFT)

BCS	+7mils	X *13M*	=	+91M
- ACTUAL	-4 mils	X *13M*	=	- (- 52M)
= ERROR				+143M

(EXPRESS TO NEAREST 10 M) OVER 140 M

USAFAS



ERRORS

Range Errors

Site

Lateral Errors

Survey direction

Range & Lateral

Observer Location

OT Direction

Target Location

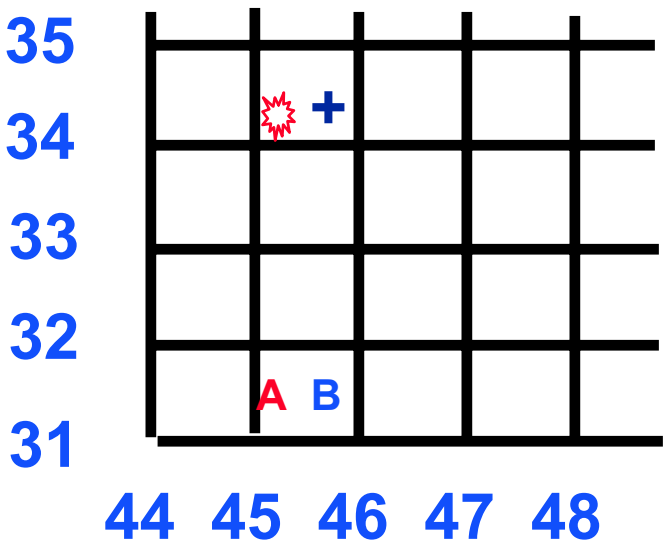
ORSTA Location

Howitzer Location

MAPMOD

ORSTA ERROR

N



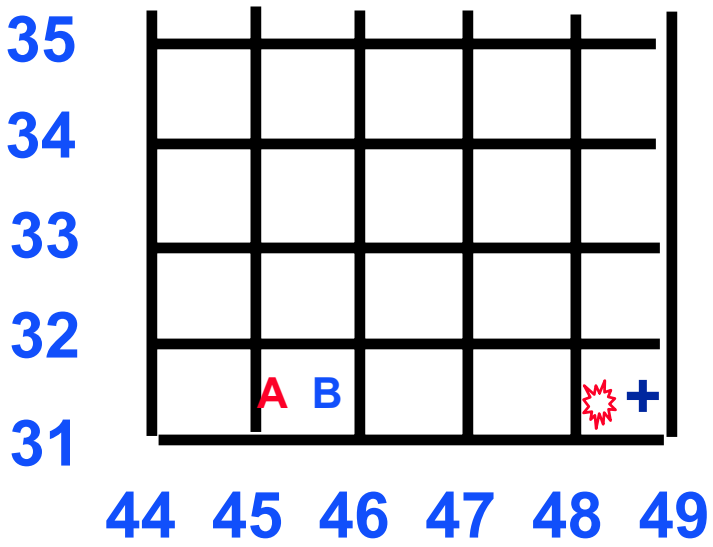
B = BCS ORSTA
A = ACTUAL ORSTA

DIR OF FIRE 6400

BCS 45810 31442 400
- ACTUAL 45310 31442 400
=ERROR 500 M WEST

USAFAS

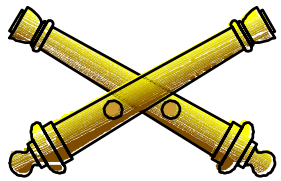
ORSTA ERROR



B = BCS ORSTA
A = ACTUAL ORSTA

DIR OF FIRE 1600

BCS 45810 31442 400
- ACTUAL 45310 31442 400
=ERROR 500 M WEST



ERRORS

Range Errors

Site

Lateral Errors

Survey direction

Range & Lateral

Observer Location

OT Direction

Target Location

ORSTA Location

Howitzer Location

MAPMOD

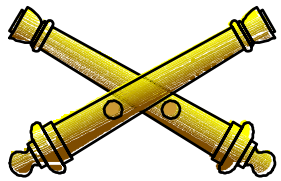
AZIMUTH OF LAY ERROR

CHG 5WB RG 5700M

ACTUAL AOL 1650
- BCS AOL 1600
=ERROR (RALS) R50 mils
x RG (1000'S) 5.7

R285M / 1.0186 = R279.8

(EXPRESS TO NEAREST 10 M) RIGHT 280M



ERRORS

Range Errors

Site

Lateral Errors

Survey direction

Azimuth of Lay

Range & Lateral

Observer Location

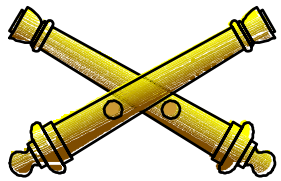
OT Direction

Target Location

ORSTA Location

Howitzer Location

MAPMOD



SQUARE WEIGHT ERROR

FIRING CHG 8 AT RG 16000M

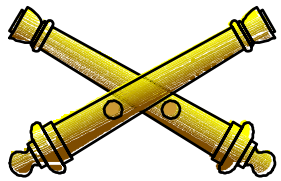
BCS HE PROJECTILE WT 93.9 LBS = 3 ◘
ACTUAL HE PROJECTILE WT 6 ◘

GO TO COL 18&19 TBL F TFT FOR RANGE CORR FOR CHANGE IN SQUARE WEIGHT

(TBL F TFT)

BCS D 1 ◘X *+24M* = +24M
- ACTUAL I 2 ◘X *- 22M* = - 44M
=ERROR +68M

(EXPRESS TO NEAREST 10 M) **OVER 70M**



ERRORS

Range Errors

Site

Projectile Weight

Lateral Errors

Survey direction

Azimuth of Lay

Range & Lateral

Observer Location

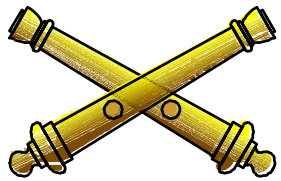
OT Direction

Target Location

ORSTA Location

Howitzer Location

MAPMOD



PROPELLANT TEMPERATURE ERROR

FIRING CHG 6WB AT RANGE 9000M

BCS PROP TEMP = 84 --> +1.1M/S *(TBL E TFT)*

ACTUAL PROP TEMP = 48 --> - 1.8M/S *(TBL E TFT)*

GO TO COL 10 & 11 TBL F TFT FOR RANGE CORR FOR +/-1M/S CHANGE IN MUZZLE VELOCITY

(TBL F TFT)

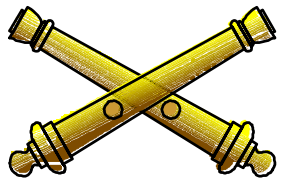
BCS I1.1M/S X *- 20.4M* = - 22.4M

\- ACTUAL D1.8M/S X *+ 20.6M* = + 37.1M

= ERROR - 59.5M

(EXPRESS TO NEAREST 10 M) SHORT 60M

USAFAS



ERRORS

Range Errors

Site

Projectile Weight

Propellant Temp

Lateral Errors

Survey direction

Azimuth of Lay

Range & Lateral

Observer Location

OT Direction

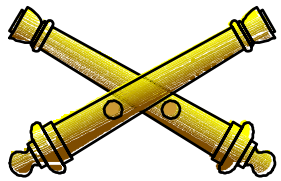
Target Location

ORSTA Location

Howitzer Location

MAPMOD

GUNNERY DEPARTMENT



MUZZLE VELOCITY VARIATION ERROR

FIRING AN M109A3 CHG 5WB@ RG 6000M

BCS (HE/M107) MV = 395.5 M/S

ACTUAL (HE/M107) MVV = -15.5 M/S

(STD MV FROM TFT)

BCS MVV =395.5M/S - *397.0 M/S* = -1.5 M/S

GO TO COL 10 & 11 TBL F TFT FOR RANGE CORR FOR +/-1M/S CHANGE IN MUZZLE VELOCITY

(TBL F TFT)

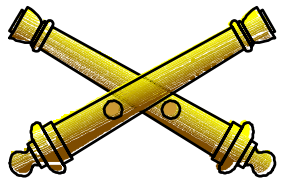
BCS => D1.5 M/S X *+16.2M* = +24.3 M

- ACTUAL => D15.5 M/S X *+16.2M* = +251.1 M

=ERROR - 226.8 M

(EXPRESS TO NEAREST 10 M) SHORT 230M

USAFAS



ERRORS

Range Errors

Site

Projectile Weight

Propellant Temp

Muzzle Velocity

Lateral Errors

Survey direction

Azimuth of Lay

Range & Lateral

Observer Location

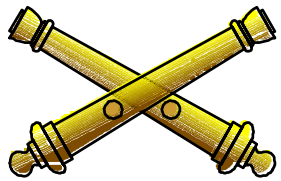
OT Direction

Target Location

ORSTA Location

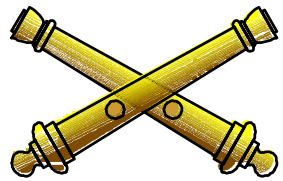
Howitzer Location

MAPMOD



MET MESSAGE ERRORS

- **Station height- Result in range corrections which will produce QE & charge errors for all guns.**
- **Wind direction/speed errors- Normally result in both range and lateral errors for all guns.**
- **Air temperature/pressure errors- Result in range errors for all guns.**
- **Air temperature/density errors- In a ballistic met will cause range errors for all guns.**



ERRORS

Range Errors

Site

Projectile Weight

Propellant Temp

Muzzle Velocity

Air Temp

Pressure

Station height

Lateral Errors

Survey direction

Azimuth of Lay

Range & Lateral

Observer Location

OT Direction

Target Location

ORSTA Location

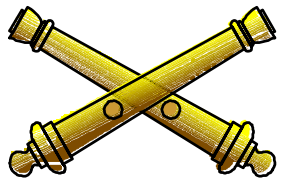
Howitzer Location

MAPMOD

Wind direction

Wind Speed

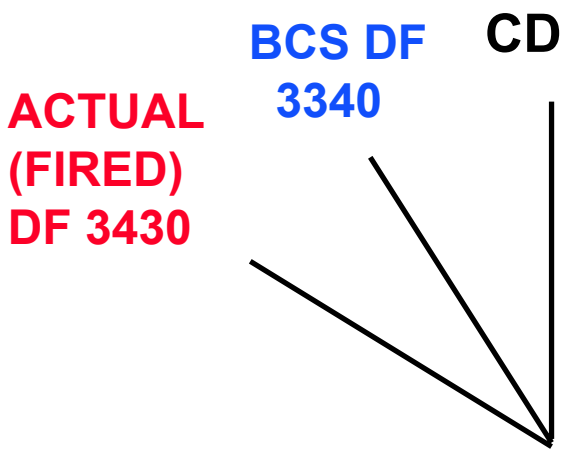
Met in use



COMPUTATIONAL PROCEDURES

- Assumes database is correct and errors are operator errors.
- Errors are found in all parts of GUNNERY TEAM. Not only in FDC and with Observers.
- Errors on gun line are equally important.

DEFLECTION FIRED ERROR



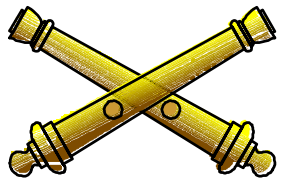
CHG 7WB
RANGE 10,800M

ACTUAL (FIRED) DF 3430
- BCS (COMPUTED) DF 3340
=ERROR (LARS) L90 mils
X RG (1000'S) 10.8
L972

L972 / 1.0186 = L954.2

(EXPRESS TO NEAREST 10 M) LEFT 950M

USAFAS



ERRORS

Range Errors

Site
Projectile Weight
Propellant Temp
Muzzle Velocity
Air Temp
Pressure
Station height

Lateral Errors

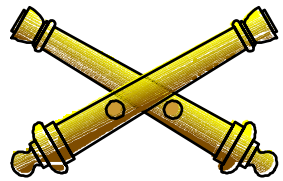
Survey direction
Azimuth of Lay
Deflection

Range & Lateral

Observer Location
OT Direction
Target Location
ORSTA Location
Howitzer Location
MAPMOD
Wind direction
Wind Speed
Met in use

GUNNERY DEPARTMENT

CHARGE ERROR



GUN #1 FIRED SH HE CHG 5GB DF 3187 QE 350
BCS COMPUTED SH HE CHG 4GB DF 3187 QE 350

ASSUME SI = 0, NO OTHER ERRORS EXIST

(TBL F TFT)

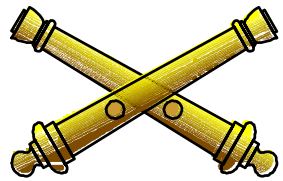
ACTUAL RG ACHIEVED *6700* *(INTERPOLATE TO NEAREST 10M)*

- BCS RG COMPUTED 5560

=ERROR +1140M

(EXPRESS TO NEAREST 10 M) **OVER 1140 M**

USAFAS



ERRORS

Range Errors

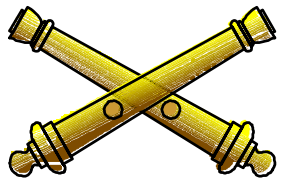
Site
Projectile Weight
Propellant Temp
Muzzle Velocity
Air Temp
Pressure
Station height
Charge

Lateral Errors

Survey direction
Azimuth of Lay
Deflection

Range & Lateral

Observer Location
OT Direction
Target Location
ORSTA Location
Howitzer Location
MAPMOD
Wind direction
Wind Speed
Met in use



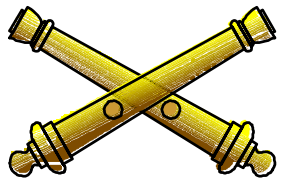
INHERENT ERRORS

- If not aware of what they are we will waste time trying to correct for errors we cannot account for.

- Conditions in the Bore
- Conditions in Carriage
- Conditions during flight

NOTE: Can be minimized by firing accurate charge & angle of fire.

GUNNERY DEPARTMENT



THE KING OF BATTLE

USAFAS